



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



# COVID-19 and investor behavior<sup>☆</sup>

Regina Ortmann<sup>\*</sup>, Matthias Pelster, Sascha Tobias Wengerek

Paderborn University, Warburger Str. 100, 33098 Paderborn, Germany



## ARTICLE INFO

### Keywords:

Trading behavior  
Retail investors  
Risk-taking  
Pandemic  
COVID-19

### JEL classification:

G10  
G11  
G12  
G40  
G41

## ABSTRACT

How do retail investors respond to the outbreak of COVID-19? We use transaction-level trading data to show that investors significantly increase their trading activities as the COVID-19 pandemic unfolds, both at the extensive and at the intensive margin. Investors, on average, increase their brokerage deposits and open more new accounts. The average weekly trading intensity increases by 13.9% as the number of COVID-19 cases doubles. The increase in trading is especially pronounced for male and older investors, and affects stock and index trading. Following the 9.99%-drop of the Dow Jones on March 12, investors significantly reduce the usage of leverage.

## 1. Introduction

The novel coronavirus has led to unprecedented repercussions on daily life and the economy. The outbreak makes investors, policy makers, and the public at large aware of the fact that natural disasters can inflict economic damage on a previously unknown scale (Goodell, 2020). While the aggregate effect of the pandemic on the stock market (Baker et al., 2020; Ramelli and Wagner, 2020; Zhang et al., 2020) and the spending behavior of households (Baker et al., 2020b) have been documented, little is known about the behavior of retail investors during such a turbulent time. Considering that retail trades move stock prices in the direction of their trades (Barber et al., 2009; Burch et al., 2016; Han and Kumar, 2013) and in particular retail short selling has predictive ability for future (negative) stock returns (Kelley and Tetlock, 2016), it is, however, important to investigate their behavior in these unprecedented conditions at the micro-level to better understand aggregate market outcomes. We investigate trading patterns and financial risk-taking of a large sample of retail investors based on their individual trading records during the outbreak of COVID-19.

We use two lines of argumentation to express contrasting expectations about investor behavior during the COVID-19 outbreak. *First*, the outbreak of the pandemic is in many regards comparable to terrorist attacks (see, e.g., Goodell, 2020): it is an exogenous shock, that has drastic consequences on everyday life, raises public fear, and causes great (economic) uncertainty. Investor behavior

<sup>☆</sup> Data were obtained under a non-disclosure agreement with a financial institution. We thank our data provider for use and explanations of their data. We thank Thomas Müller for outstanding research support. We are grateful for helpful comments and suggestions from seminar participants at Paderborn University. Regina Ortmann gratefully acknowledges financial support by the German Research Foundation (DFG) - Collaborative Research Center (SFB/TRR) Project-ID 403041268 - TRR 266 Accounting for Transparency. Any errors, misrepresentations, and omissions are our own.

<sup>\*</sup> Corresponding author.

E-mail addresses: [regina.ortmann@upb.de](mailto:regina.ortmann@upb.de) (R. Ortmann), [matthias.pelster@upb.de](mailto:matthias.pelster@upb.de) (M. Pelster), [sascha.tobias.wengerek@upb.de](mailto:sascha.tobias.wengerek@upb.de) (S.T. Wengerek).

<https://doi.org/10.1016/j.frl.2020.101717>

Received 22 May 2020; Received in revised form 29 July 2020; Accepted 7 August 2020

Available online 08 August 2020

1544-6123/ © 2020 Elsevier Inc. All rights reserved.

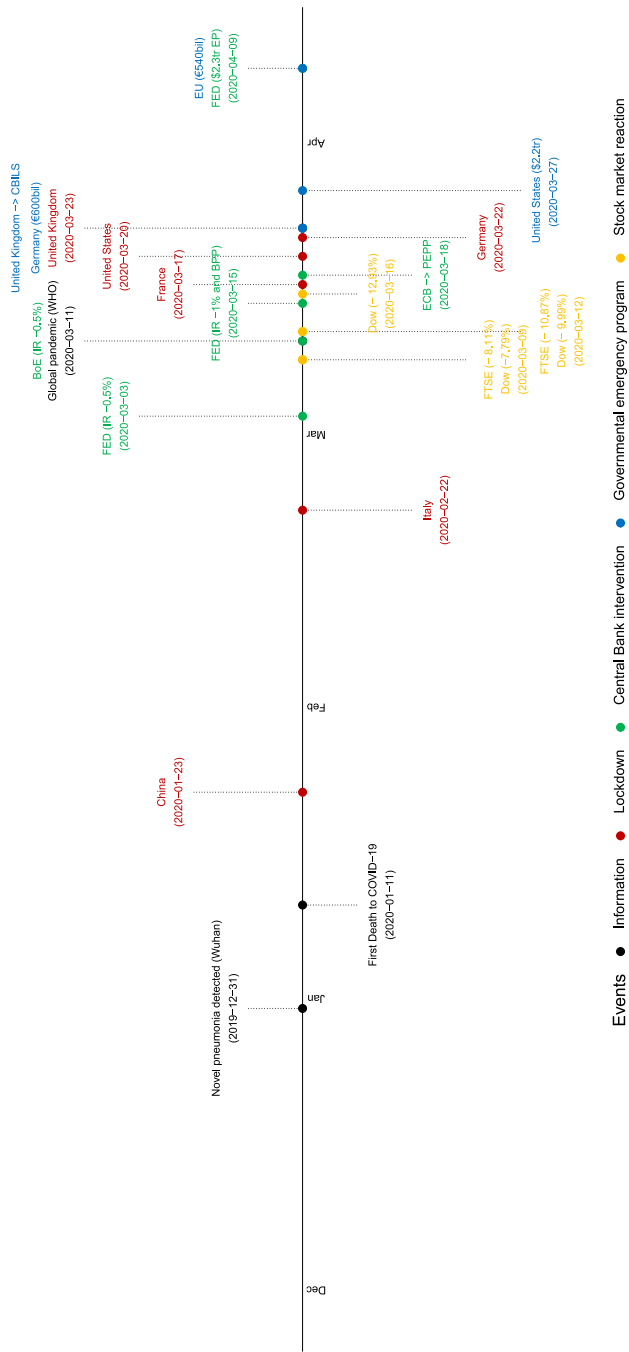


Fig. 1. Key events during the outbreak of COVID-19. This figure shows the key events during the outbreak of the pandemic.

in the aftermath of terrorist activity is associated with more risk averse choices, such as a reduced trading intensity and a reduced flow to risky assets (Levy and Galili, 2006; Luo et al., 2020; Wang and Young, 2020). Burch et al. (2016) show heavy retail investor selling in the crisis period set off by 9/11 that drives down asset prices. In line with these results, but against the background of the outbreak of COVID-19, Bu et al. (2020) survey Chinese students in Wuhan and find substantially lower general preferences for risk. Individuals that are more exposed to COVID-19 consequences display a decreased willingness to take risky investments and more pessimistic beliefs on the economy. Thus, in response to the outbreak of COVID-19, investors may reduce their market exposure and risk-taking.

Second, in line with this increased uncertainty, press articles, media reports, and expert opinions display a torn image of the future economic development and, thus, of optimal investment and portfolio strategies. The outbreak of COVID-19 has led to significant financial market declines and increased financial market risks around the world (Zhang et al., 2020). Central banks and governments have thrown their policy instruments into the market and launched support programs never seen before (see Fig. 1). In spite of these support programs, a great deal of uncertainty persists. With the exact global economic impacts not yet clear, different opinions circulate. Whereas, for example, President Donald Trump confidently proclaimed that there will be a quick V-shaped recovery of the US economy and Hanspal et al. (2020) report that US households expect a faster recovery of the stock market relative to previous crashes, Janet Yellen expressed that it is common for economic growth after a crisis to remain on a lower track for years, not months (Lee, 2020). Against the backdrop of these inconclusive expectations, it is highly interesting to investigate investors' trading activities during the outbreak of COVID-19.

We show that investors increase their average weekly trading intensity by 13.9% as the number of COVID-19 cases doubles. Investors, on average, add funds to their accounts, open more new accounts, and establish more new positions. We observe the largest increase in trading between February 23, and March 22. Yet, investors also significantly reduce their usage of leverage after the 9.99%-drop of the Dow Jones Industrial Average (Dow) on March 12.

The remainder of our paper proceeds as follows. We present the data and our methodology in the next section. In Section 3, we present the results. In the final section, we discuss our findings and conclude.

## 2. Data and methodology

We use transactional-level brokerage data from a discount broker that offers an online trading platform to retail investors under a UK broker license. Our data sample contains all trades that the investors executed with the broker between August 1, 2019 and April 17, 2020. The data contain the exact time-stamp and instrument of the trade, together with an indicator for long or short positions, and the leverage. In total, the dataset comprises 45,003,637 transactions executed by 456,365 investors. Additionally, it includes the deposits to and withdrawals from the brokerage accounts. The data also contain details of push notifications that inform investors of volatility events (see Arnold et al., 2020). Lastly, the dataset comprises basic demographic information. We obtain data on the number of COVID-19 cases from the European Centre for Disease Prevention and Control.

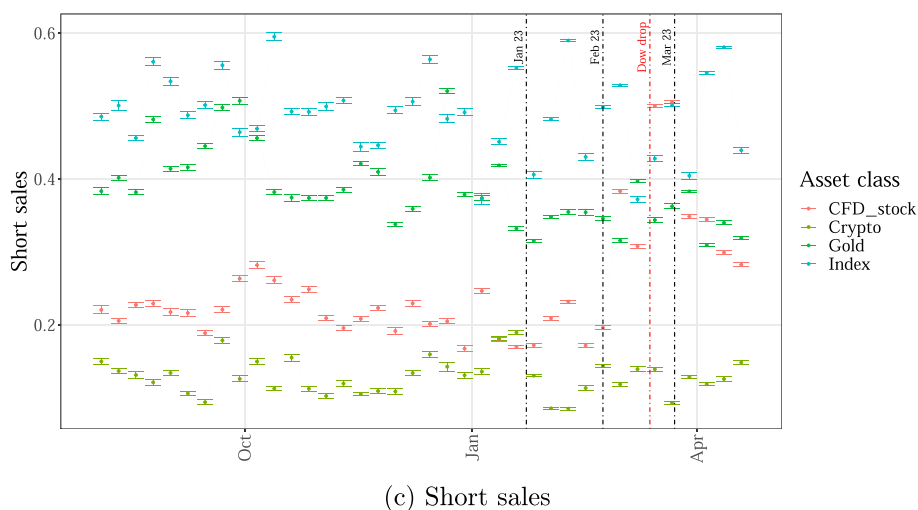
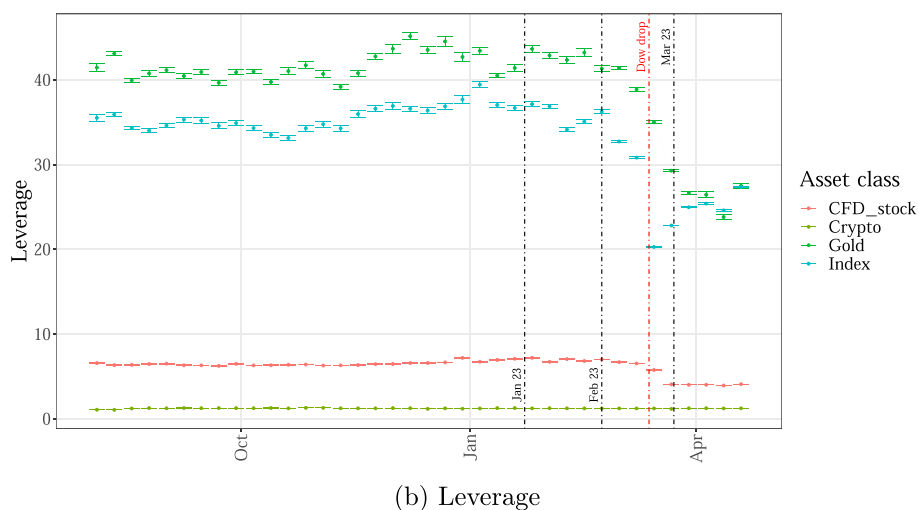
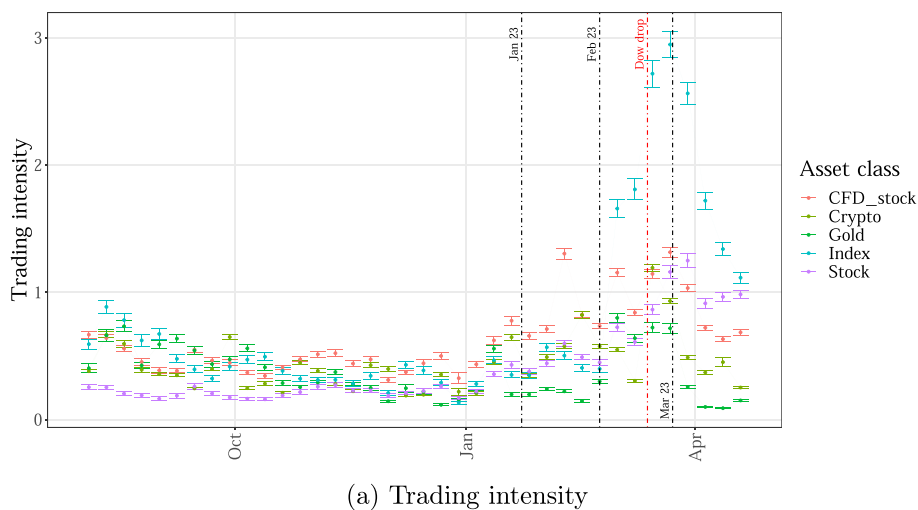
We study the relation between the outbreak of COVID-19 and investors' trading activities using an OLS regression analysis. We use several variables to proxy investors' trading activities. *Trading intensity* denotes the number of trades in a given week. The variable takes a value of zero for investors who do not trade in a given week. *Leverage*, a pure measure of risk-taking, denotes the leverage employed for a trade. *Short sale* is a dummy variable that takes a value of one, if a trade establishes a short position, and zero otherwise. *Abnorm. net deposits* denotes the number of deposits minus the number of withdrawals on a given day, divided by the average net deposits prior to the outbreak of the pandemic. *Abnorm. first deposits* denotes the number of deposits by investors who opened a new account on a given day, divided by the average first deposits prior to the outbreak of the pandemic. Buy-sell imbalances (BSI) denote the relation between long minus short to total positions. Finally, abnormal trading volume in an industry denotes the trading volume on day  $t$  divided by the average trading volume in that industry over the last six months.

To capture the outbreak of the pandemic, we use the following variables. *COVID-19* denotes the logarithm of the number of corona cases plus one. *Dow drop* is a dummy variable that takes a value of one on March 13, the day after the Dow and the FTSE, the UK's main index, recorded major losses, and zero otherwise. The Dow fell a record 2,352.60 points (9.99%) to close at 21,200.62. The FTSE dropped more than 10% and recorded its worst day since 1987. Lastly, we use three dummy variables to define various stages of the outbreak. The first stage (Jan. 23–Feb. 22) begins when China ordered the lockdown. At this time, investors will have started to understand the importance of the disease, as this lockdown affected supply chains in Europe and other parts of the world. The second stage (Feb. 23–Mar. 22) begins when Italy ordered the lockdown in February, as then the disease had become a pandemic that reached Europe. The third stage (Mar. 23–Apr. 17) begins when the UK ordered the lockdown in March, as a large part of countries across the world had already issued lockdowns or severe restrictions on public life by then (see Fig. 1).

Our specification includes investor fixed effects to control for observed and unobserved heterogeneity across investors such as their demographics or wealth. We also include a full set of asset class dummies to control for different trading behaviors across asset classes. Lastly, we control for push notifications before investors' trades, as Arnold et al., 2020 show that such push notifications increase risk-taking and trading within a 24-hour time period.

## 3. Results

We present the evolution of investors' trading activities in Fig. 2 in detail. We observe a significant increase in index trading, mostly between February 23, and March 23, which decreases again after March 23. Slightly less pronounced, we observe an increase in stock trading, followed by a decline after March 23. Contracts for difference (CFD) trading on stocks shows several spikes over the



**Fig. 2.** Trading activities over time. This figure presents the trading intensity, leverage-usage, and short sale propensity over time (with 99% confidence intervals).

course of the pandemic. Crypto trading shows a distinct spike following the drop of the Dow on March 12. Fig. 2(b) shows a decline in leverage-usage across asset classes between February 23, and March 23, that is most pronounced following the drop of the Dow. Panel (c) shows an increase in short-selling using CFDs on stocks, but no clear trend across other asset classes.

Table 1 presents our main results. Panel A, Model 1 shows a 13.9% increase in the average weekly trading intensity, compared to the average trading before the pandemic, as the number of COVID-19 cases doubles. The increase in trading is mainly driven by male investors (Model 4) and by older investors (Model 5). Model 2 shows that the trading intensity increased by 222%, compared to the average trading before the pandemic, following the 9.99%-drop of the Dow on March 12, which is largely driven by the spike in cryptocurrency trading (untabulated). Finally, Model 3 shows that the largest increase in trading is observed between February 23, to March 22. Table 1, Panel B, shows that the increase in trading is driven by increased stock and index trading, while CFDs on stocks, cryptocurrencies, and gold are less affected. The increase in trading is also prevalent for new created positions in stocks and indices (Panel C).

Table 2 shows that investors, on average, add additional funds to their trading accounts. The abnormal net deposits increase by 0.41 (Model 1) as the cases number doubles. The increase in fund-flow is driven by both new (Model 2) and established investors (Model 3). Thus, investors increase their trading activities not only at the intensive but also at the extensive margin (see also Fig. 3).

Panels D and E of Table 1 show a large decline in leverage-usage across all genders and age groups during the outbreak. The largest decline can be observed following the Dow drop on March 12. As a response, investors reduced their average leverage-usage by 172 percentage points.

Panels F and G show that investors increase their propensity to take short positions by, on average, 2% of their propensity to engage in short positions before the outbreak of COVID-19. We observe an increase in short selling activities across all asset classes (Panel G), which is especially pronounced for the more recent time periods (Panel F, Model 3) and younger investors (Panel F, Model 5).<sup>1</sup>

Fig. 4 presents BSI over time. Investors, on average, take long stock positions, and this tendency increases during the outbreak of the pandemic. BSI for index positions and gold move around zero, indicating neutral positions, on average. Cryptocurrencies show two spikes towards long positions around February 23, and March 23. CFD stock positions overall show strong variation during the outbreak, with more short positions until March 23, and a tendency towards long positions afterwards.

Lastly, we study the investor behavior with a focus on industries, based on the North American Industry Classification System (NAICS). We study the abnormal trading volume and the fraction of short sales jointly for stock trading and CFDs on stocks. Fig. 5 shows the evolution for the five industries that record the largest values in these variables during our sample period. We observe the highest abnormal trading volume in *Transit and Ground Passenger Transportation*, *Motion Picture and Sound Recording Industries*, *Accommodation*, *Water Transportation*, and *Air Transportation*. We find the highest short selling in *Motion Picture and Sound Recording Industries*, *Accommodation*, *Air Transportation*, *Supportive Activities for Transportation*, and *Administrative and Support Services*, which includes travel-related companies such as TripAdvisor, Expedia, or TUI. We show that the trading volume starts to increase during the period from January 23, to February 23, in particular for the *Accommodation* and *Water transportation* industries. The timing coincides with the first cruise ship having a major outbreak on board and being quarantined from February 4, onward. We also find an early increase in short selling in the most affected industries, such as the *Accommodation*, *Air Transportation*, or *Administrative and Support Services* industries, at the beginning of February, more than a month before the large spikes in March.

#### 4. Discussion

We show that investors increase their trading activities as the COVID-19 pandemic unfolds, both at the extensive and at the intensive margin. The number of investors who first open an account with the broker increases, while at the same time established investors increase their average trading activities. Investors, on average, significantly increase their weekly trading intensity by 13.9% as the number of COVID-19 cases doubles. In particular, investors open more stock and index positions, but do not move to safe-haven (gold) or particularly “risky” (CFDs on stocks, cryptocurrencies) investments. The increase in trading is especially pronounced for male and older investors, and largest during the period from February 23, to March 22. Investors also marginally increase their tendency to engage in short selling. Stock trading increases most for industries that tend to be losers as the crisis progresses. Here, especially travel-related industries are exposed to early short selling at the beginning of February, in line with the notion that retail short selling has predictive ability for future stock returns (Kelley and Tetlock, 2016).

Our results indicate that, in line with the torn image that press articles, media reports, and expert opinions paint these days, investors’ trading activities are also not clear-cut. Our findings stand in contrast to investors’ reactions to other shocks that increase uncertainty, such as terrorist attacks, which are associated with reduced flows to risky asset classes (Wang and Young, 2020) and heavy retail investor selling (Burch et al., 2016). While investors increase their trading intensity and more readily open new positions, we nonetheless show that investors act more cautiously following the drop of the Dow on March 12. Following the 9.99%-drop of the

<sup>1</sup> In additional (untabulated) analyses, we study the trading patterns and risk-taking of investors during other recent market downturns, such as the drastic drop of the Dow in December 2018. A comparison of the results from past market downturns and activities around the COVID-19 outbreak indicates that investors’ activities around the outbreak of COVID-19 are unique, in line with the unprecedented nature of the crisis. In particular, changes in trading amount to at most 5% of the effect size that we observe during the outbreak of the pandemic. Moreover, we observe that investors, on average, withdraw funds from their accounts, open fewer new accounts, and do not significantly change their risk-taking during other recent market downturns.

**Table 1**

Regression results: trading activities. This table reports results from an OLS regression on the trading activities of investors. Standard errors are double-clustered at the individual investor level and over time; *t*-statistics are in parentheses. \*\* and \* denote statistical significance at the 1% and 5% levels, respectively.

Panel A: Trading intensity					
	Model 1	Model 2	Model 3	Model 4	Model 5
Dependent variable	Trading intensity	Trading intensity	Trading intensity	Trading intensity	Trading intensity
COVID-19	0.2220* (2.3004)			0.1202 (1.5625)	0.2129* (2.2849)
Dow drop		3.5557** (11.4704)			
Jan. 23–Feb. 22			0.2763 (1.1377)		
Feb. 23–Mar. 22			2.7410** (3.3521)		
Mar. 23–Apr. 17			0.6378 (1.2035)		
Cases · male				0.1130** (4.0556)	
Cases · 18–24					− 0.1714** (−3.4184)
Cases · 25–34					− 0.0150 (−0.4196)
Cases · 35–44					0.0542 (1.4619)
Cases · 45–54					0.0950* (2.4387)
Cases · 55–64					0.0475 (1.3193)
Push message control	Yes	Yes	Yes	Yes	Yes
Asset class dummy	Yes	Yes	Yes	Yes	Yes
Investor-fixed effects	Yes	Yes	Yes	Yes	Yes
Obs.	14,113,014	14,525,010	14,525,010	14,088,650	14,072,248
Adj. <i>R</i> <sup>2</sup>	0.36	0.37	0.37	0.36	0.36
Panel B: Trading intensity by asset classes					
	Model 1	Model 2	Model 3	Model 4	Model 5
Sample	Stocks	CFD_stock	Index	Crypto	Gold
COVID-19	0.0363** (5.1362)	0.0142 (0.9807)	0.1813** (4.0297)	− 0.0008 (−0.0463)	− 0.0165 (−1.4860)
Push message control	Yes	Yes	Yes	Yes	Yes
Investor-fixed effects	Yes	Yes	Yes	Yes	Yes
Obs.	14,113,014	14,113,014	14,113,014	14,113,014	14,113,014
Adj. <i>R</i> <sup>2</sup>	0.37	0.34	0.30	0.27	0.23
Panel C: Trading intensity (new positions) by asset classes					
	Model 1	Model 2	Model 3	Model 4	Model 5
Sample	Stocks	CFD_stock	Index	Crypto	Gold
COVID-19	0.0195** (5.1803)	0.0068 (0.9776)	0.0910** (4.0396)	− 0.0028 (−0.3065)	− 0.0083 (−1.4974)
Push message control	Yes	Yes	Yes	Yes	Yes
Investor-fixed effects	Yes	Yes	Yes	Yes	Yes
Obs.	14,113,011	14,113,011	14,113,011	14,113,011	14,113,011
Adj. <i>R</i> <sup>2</sup>	0.37	0.33	0.30	0.28	0.23
Panel D: Leverage					
	Model 1	Model 2	Model 3	Model 4	Model 5
Dep. var.	Leverage	Leverage	Leverage	Leverage	Leverage
COVID-19	− 0.3019** (−8.3412)			− 0.3155** (−5.8471)	− 0.2406** (−4.0663)
Dow drop		− 1.7197** (−6.9803)			
Jan. 23 - Feb. 22			0.4080*		

(continued on next page)

Table 1 (continued)

Panel D: Leverage					
	Model 1	Model 2	Model 3	Model 4	Model 5
Feb. 23 - Mar. 22			(2.0808) − 1.0652 (−1.4160)		
Mar. 23 - Apr. 17			− 2.9917** (−8.9368)		
Cases · male				0.0146 (0.3624)	
Cases · 18–24					0.0033 (0.0484)
Cases · 25–34					− 0.0970 (−1.5689)
Cases · 35–44					− 0.0963 (−1.6319)
Cases · 45–54					− 0.0114 (−0.1945)
Cases · 55–64					0.0040 (0.0639)
Push message control	Yes	Yes	Yes	Yes	Yes
Asset class dummy	Yes	Yes	Yes	Yes	Yes
Investor-fixed effects	Yes	Yes	Yes	Yes	Yes
Obs.	4,771,217	4,946,112	4,946,112	4,767,966	4,758,012
Adj. R <sup>2</sup>	0.64	0.64	0.64	0.64	0.64
Panel E: Leverage by asset classes					
	Model 1	Model 2	Model 3	Model 4	
Dep. var.	Leverage	Leverage	Leverage	Leverage	Leverage
Sample	CFD_stock	Index	Crypto	Gold	Gold
COVID-19	− 0.1530**	− 0.5289**	0.0045**		
− 0.5121** (−7.3752)		(−11.5243)	(−12.9833)		(2.7170)
Push message control	Yes	Yes	Yes	Yes	Yes
Investor-fixed effects	Yes	Yes	Yes	Yes	Yes
Obs.	1,040,042	650,338	1,174,571	591,974	
Adj. R <sup>2</sup>	0.64	0.76	0.55		0.79
Panel F: Short sales					
	Model 1	Model 2	Model 3	Model 4	Model 5
Dependent variable	Short sales	Short sales	Short sales	Short sales	Short sales
COVID-19	0.0056** (7.3213)			0.0055** (5.5340)	0.0028** (3.3955)
Dow drop		0.0158* (2.5069)			
Jan. 23 - Feb. 22			− 0.0004 (−0.0798)		
Feb. 23 - Mar. 22			0.0315** (3.5548)		
Mar. 23 - Apr. 17			0.0364** (6.9650)		
Cases · male				0.0000 (0.1031)	
Cases · 18–24					0.0061** (4.4759)
Cases · 25–34					0.0044** (5.4906)
Cases · 35–44					0.0020** (2.9686)
Cases · 45–54					0.0010 (1.4507)
Cases · 55–64					− 0.0002 (−0.2507)
Push message control	Yes	Yes	Yes	Yes	Yes
Asset class dummy	Yes	Yes	Yes	Yes	Yes

(continued on next page)



Table 1 (continued)

Panel F: Short sales					
	Model 1	Model 2	Model 3	Model 4	Model 5
Investor-fixed effects	Yes	Yes	Yes	Yes	Yes
Obs.	4,771,217	4,946,112	4,946,112	4,767,966	4,758,012
Adj. $R^2$	0.15	0.15	0.15	0.15	0.15

Panel G: Short sales by asset classes				
	Model 1	Model 2	Model 3	Model 4
Dependent variable	Short sales	Short sales	Short sales	Short sales
Sample	CFD_stock	Index	Crypto	Gold
COVID-19	0.0112** (5.2606)	0.0033** (2.9362)	0.0039** (4.5214)	0.0041 (1.9366)
Push message control	Yes	Yes	Yes	Yes
Investor-fixed effects	Yes	Yes	Yes	Yes
Obs.	1,047,042	650,338	1,174,571	591,974
Adj. $R^2$	0.15	0.04	0.09	0.08

Table 2

Regression results: account deposits. This table reports results from an OLS regression on deposits and withdrawals. Standard errors are robust;  $t$ -statistics are in parentheses. \*\* and \* denote statistical significance at the 1% and 5% levels, respectively.

	Model 1	Model 2	Model 3
Dependent variable	Abnorm. net deposits	Abnorm. first deposits	Abnorm. net deposits
Sample	Full sample	New investors	Established investors
(Intercept)	1.0611** (9.1315)	1.0007** (32.0302)	1.0532** (18.6130)
COVID-19	0.4132** (5.9015)	0.2825** (12.0879)	0.1373* (2.5400)
Obs.	261	261	261
Adj. $R^2$	0.19	0.55	0.04

Dow, investors reduce their leverage-usage, which is in line with the notion that investors make more risk-averse choices due to public fear (Levy and Galili, 2006; Luo et al., 2020; Wang and Young, 2020). The fact that (i) buy-sell imbalances in index positions are close to zero and (ii) some investors take long stock positions while others short single name stocks using CFDs, underscores that investors have different expectations, in line with the torn picture experts and media outlets paint. Investors who take long stock or index positions may buy into the narrative of the fast economic recovery once the pandemic passes (Hanspal et al., 2020), and believe

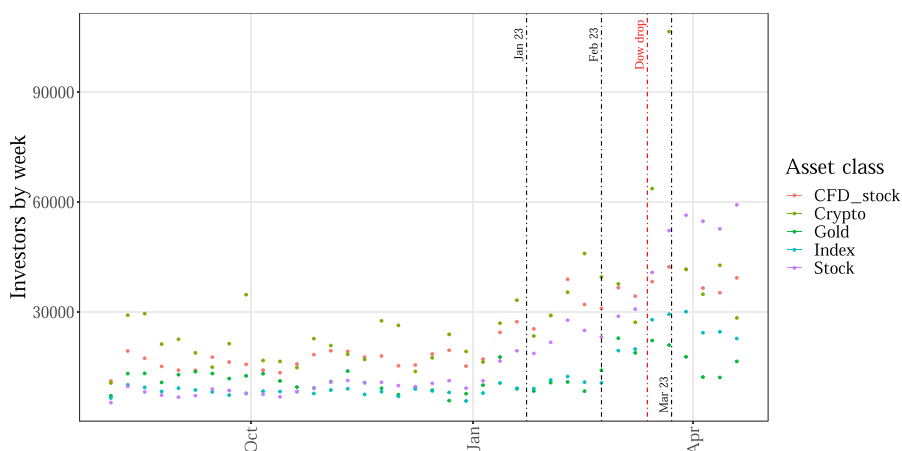
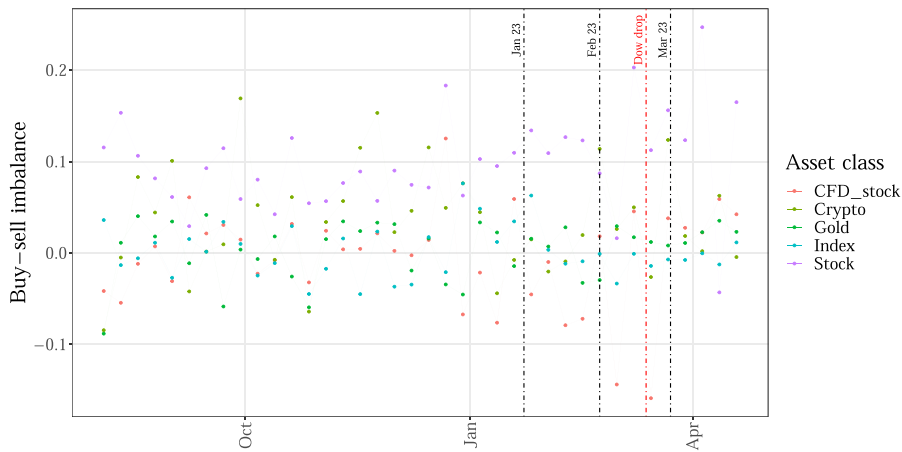
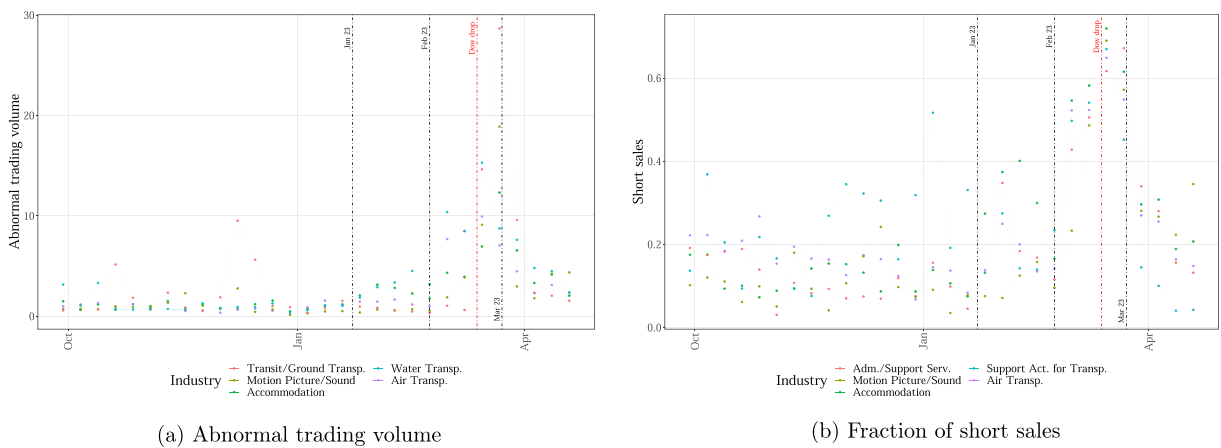


Fig. 3. Number of active investors. This figure presents the number of active investors over time.



**Fig. 4.** Buy-sell imbalances during the COVID-19 outbreak. This figure presents the buy-sell imbalances over time.



**Fig. 5.** Most affected industries. This figure presents the abnormal trading volume and short sale propensity of the five most affected industries, respectively, over time.

that the lockdown offers a favorable opportunity to enter the stock market, while those taking short positions may hold the opinion that this narrative is too optimistic. Inconsistencies between investors' short-term and long-term expectations created by unlimited quantitative easing programs (Gormsen and Koijen, 2020) may further contribute to ambiguous investor behaviors.

A caveat of our analysis is that investors in our dataset may not be representative of the average household. Investors likely select a brokerage service based on their preferences. Notwithstanding this limitation, we believe that our study provides important insights into the trading activities of retail investors during the outbreak of the pandemic. Our study provides initial insights that may inform future research that attempts to explore the impact of the outbreak of a pandemic on retail investor behavior further.

#### CRedit authorship contribution statement

**Regina Ortmann:** Investigation, Writing - original draft, Writing - review & editing, Validation. **Matthias Pelster:** Conceptualization, Methodology, Data curation, Writing - original draft, Writing - review & editing, Formal analysis, Project administration, Validation. **Sascha Tobias Wengerek:** Methodology, Data curation, Writing - original draft, Formal analysis, Visualization, Validation.

#### Supplementary material

Supplementary material associated with this article can be found, in the online version, at [10.1016/j.frl.2020.101717](https://doi.org/10.1016/j.frl.2020.101717)

#### References

Arnold, M., Pelster, M., Subrahmanyam, M.G., 2020. Attention triggers and investors' risk taking. TAF Working Paper Series. 55 Paderborn University.

- Baker, S.R., Bloom, N., Davis, S.J., Kost, K., Sammon, M., Viratyosin, T., 2020a. The unprecedented stock market reaction to COVID-19. Working Paper.
- Baker, S.R., Farrokhnia, R.A., Meyer, S., Pagel, M., Yannelis, C., 2020b. How does household spending respond to an epidemic? consumption during the 2020 COVID-19 pandemic. Working Paper 26949. National Bureau of Economic Research.
- Barber, B.M., Odean, T., Zhu, N., 2009. Do retail trades move markets? *Rev. Financ. Stud.* 22, 151–186.
- Bu, D., Hanspal, T., Liao, Y., Liu, Y., 2020. Risk taking during a global crisis: evidence from Wuhan. Working Paper.
- Burch, T.R., Emery, D.R., Fuerst, M.E., 2016. Who moves markets in a sudden marketwide crisis? Evidence from 9/11. *J. Financ. Quant. Anal.* 51, 463–487.
- Goodell, J.W., 2020. COVID-19 and finance: agendas for future research. *Finance Res. Lett.* 35, 101512.
- Gormsen, N.J., Koijen, R.S.J., 2020. Coronavirus: impact on stock prices and growth expectations. Working Paper 2020-22. University of Chicago.
- Han, B., Kumar, A., 2013. Speculative retail trading and asset prices. *J. Financ. Quant. Anal.* 48, 377–404.
- Hanspal, T., Weber, A., Wohlfart, J., 2020. Income and wealth shocks and expectations during the COVID-19 pandemic. Working Paper 13/20. University of Copenhagen.
- Kelley, E.K., Tetlock, P.C., 2016. Retail short selling and stock prices. *Rev. Financ. Stud.* 30, 801–834.
- Lee, D., 2020. Coronavirus recession now expected to be deeper and longer. *Los Angeles Times* 04/01/2020.
- Levy, O., Galili, I., 2006. Terror and trade of individual investors. *J. Socio Econ.* 35, 980–991.
- Luo, Y., Chen, Y., Lin, J.-C., 2020. Do terrorist attacks make inventors more risk taking? Working Paper.
- Ramelli, S., Wagner, A.F., 2020. Feverish stock price reactions to COVID-19. *Review of Corporate Finance Studies*. Oxford Academic. In press.
- Wang, A.Y., Young, M., 2020. Terrorist attacks and investor risk preference: Evidence from mutual fund flows. *Jour. Fin. Eco.* 137 (2), 491–514.
- Zhang, D., Hu, M., Ji, Q., 2020. Financial markets under the global pandemic of COVID-19. *Finance Res. Lett.*, 101528. In press.